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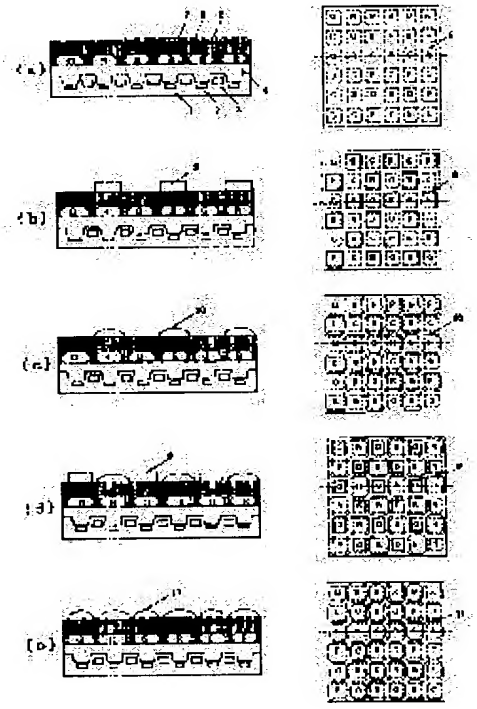
(54) SOLID-STATE IMAGE PICKUP ELEMENT AND ITS MANUFACTURE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a solid-state image pickup element which can be improved in sensitivity for all colors and the color reproducing area of which can be expanded.

SOLUTION: Since a solid-state image pickup element is constituted, in such a way that the size of a micro-lens formed on the color filter 5 for one color is made different from those of microlenses formed on the color filters for the other colors, the spectrum sensitivity of the image pickup element can be improved by making the sizes of the microlenses for low-sensitivity colors (for example, blue and red) larger than that of the microlens 11 for a high- sensitivity color (for example, green). Therefore, the noise of the element can be reduced in the low-sensitivity colors.



LEGAL STATUS

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a solid state image sensor and its manufacture approach with a micro lens.
[0002]
[Description of the Prior Art] Conventionally, in a solid state image sensor, since the field which does not contribute to photo electric conversion, such as the charge transfer section, exists in each pixel, there is a problem which the numerical aperture to the light-receiving side of a light sensing portion occupied to the whole pixel side is about 15 - 30%, and is said that the utilization factor of incident light is not enough. Although the attempt which makes area of the transfer register section small and enlarges light sensing portion area and opening area by introducing the technique made detailed and high energy ion injection technique of fields other than the light sensing portion by the semi-conductor process, and raising the amount of saturation charges of the transfer register section is made in order to solve such a problem and to attain the improvement in sensibility, these have a limitation structurally [a solid state image sensor]. So, in recent years, as shown in drawing 3 (c), a convex type micro lens is prepared in the light sensing portion upper part, and the image sensor with the micro lens on chip which the light sensing portion was made to condense efficiently the light which carried out incidence, and raised the effective numerical aperture is offered.
[0003] Furthermore, in addition to the micro lens, it has the color filter in the color solid state image sensor. The general manufacture approach that the light sensing portion which performs photo electric conversion in the substrate surface section forms a color filter and a micro lens in the image sensor currently formed two or more places is as follows.
** Formation of the flattening ** micro lens of the color filter by the formation ** transparence resin of the flattening ** color filter of the stopgap ** light sensing portion of the light sensing portion by the transparence resin of a light sensing portion [0004] Formation of ** micro lens is especially explained with reference to a drawing. Drawing 3 is the explanatory view of the manufacture approach of the conventional micro lens. 1 -- for the charge transfer section and 4, as for a color filter and 6, a lower flattening layer and 5 are [a semi-conductor substrate and 2 / a light sensing portion and 3 / a light-shielding film and 7] up flattening layers (refer to drawing 3 (a)). After applying the resist for micro lenses which is a micro-lens ingredient and forming a pattern 12 with the conventional photolithography technique on an up flattening layer (refer to drawing 3 (b)), perform heat-treatment, a pattern is made to transform and the light sensing portion convex-like micro lens 13 is formed (refer to drawing 3 (c)).
[0005] In recent years, it is necessary with high-resolution-izing and a miniaturization of a solid state image sensor to make a micro lens highly minute. Since the light-receiving area of a light sensing portion becomes small collectively, it is desirable to expand the width of face of a lens, maintaining the condensing location of a micro lens, and to make distance between lenses as small as possible. That is, it is desirable to make the tooth space between micro lenses of drawing 3 (c) as small as possible.
[0006]
[Problem(s) to be Solved by the Invention] However, even if it only made the tooth space between micro lenses small for the limitation of the spectral transmittance of a color filter, i.e., the color-separation ability of a color filter, and the photo-electric-conversion wavelength dependency of an optoelectric transducer, the color with which it is not fully satisfied of sensibility existed, and there was a trouble of narrowing the color reproduction field of a solid state image sensor.

[0007] Then, this invention aims at offer of the solid state image sensor which the sensibility of all colors is raised and can be improved in a color reproduction field.
[0008]
[Means for Solving the Problem] In the solid state image sensor which this invention was made in view of the above-mentioned technical problem, and invention according to claim 1 was equipped with two or more light sensing portions on the semi-conductor substrate, and formed the color filter and the micro lens on said light sensing portion, it is the solid state image sensor with which magnitude of the micro lens formed on the color filter of the color of 1 is characterized by differing from the magnitude of the micro lens formed on the color filter of other colors.
[0009] Invention according to claim 2 is a solid state image sensor characterized by for a color filter consisting of primary color filters on the assumption that invention according to claim 1, and a filter array having a BEIYA method and an INTARAIN method.
[0010] Invention according to claim 3 is the manufacture approach of a solid state image sensor that the magnitude of the micro lens formed on the color filter of the color of 1 differs from the magnitude of the micro lens formed on the color filter of other colors, and after forming a micro lens on the color filter of the color of 1, it is the manufacture approach of the solid state image sensor characterized by forming a micro lens on the color filter of other colors.
[0011]
[Embodiment of the Invention] [Example 1] The 1st example of this invention is explained with reference to a drawing below. Drawing 1 is the explanatory view of the cross-section structure which showed the production process of the solid state image sensor concerning an example 1, and the planar structure. Drawing 1 (a) is the sectional view of the solid state image sensor when forming a color filter in a solid state image sensor, and forming the Gokami section flattening layer. 1 -- as for a light sensing portion and 3, a lower flattening layer and 5 are up flattening layers, since it is the same as the conventional configuration, a color filter and 6 attach [a light-shielding film and 7] the same sign, and the charge transfer section and 4 omit [a semi-conductor substrate and 2] explanation.
[0012] Next, as shown in drawing 1 (b), the patterns 8 and 9 which consist of a resist for micro lenses of different magnitude (width of face) in checkers are formed on the up flattening layer 7, and micro lenses 10 and 11 are formed by heat-treatment. That is, on the color filter of G (green / color of 1), a micro lens with big lens width of face is formed for a micro lens with small lens width of face on the color filter of R (color besides red/), and B (color besides blue/) (that is, the magnitude of the micro lens of G, R, and B differs). In addition, the height of a big micro lens and a small micro lens is abbreviation identitas. The spectral sensitivity of R with low sensibility (red) and B (blue) can be improved by this, and the color reproduction field of a solid state image sensor can be extended by arranging the spectral sensitivity of R, G, and B.
[0013] About the 2nd example of [example 2] this invention, a drawing is made reference and explained. Drawing 2 is the explanatory view of the cross-section structure which showed the production process of the solid state image sensor which is an example 2, and the planar structure. Drawing 2 (a) is the sectional view of the solid state image sensor when forming a color filter in a solid state image sensor, and forming the Gokami section flattening layer. 1 -- as for a light sensing portion and 3 charge transfer section, a lower flattening layer and 5 are up flattening layers, since it is the same as the conventional configuration, a color filter and 6 attach [a light-shielding film and 7] the same sign, and 4 omits [a semi-conductor substrate and 2] explanation.
[0014] In addition, as for the filter array of a color filter, it is desirable to have the BEIYA method or INTARAIN method with which the same color is located in a line in checkers from a viewpoint which prevents the welding of a micro lens.
[0015] Next, as shown in drawing 2 (b), a pattern 8 is formed with the conventional photolithography technique on checkered, i.e., the color filter of R (red) and B (blue), on the up flattening layer 7, and the micro lens 10 with large lens width of face is formed by heat-treatment (refer to drawing 2 (c)). Then, as shown in drawing 2 (d), a pattern 9 and the micro lens 11 with small lens width of face are formed by the approach that it is the same on the color filter of G (green) (refer to drawing 2 (e)). In addition, according to this manufacture approach, it is also possible by changing the thickness of a pattern to change the height of a big micro lens and a small micro lens. Moreover, it is also possible to change the rate of condensing by using the micro-lens formation resist from which a refractive index differs. The spectral sensitivity of R with low sensibility (red) and B (blue) can be improved further by this, and the color reproduction field of a solid state image sensor can

be extended.
[0016]
[Effect of the Invention] As mentioned above, since the magnitude of the micro lens formed on the color filter of the color of 1 takes different structure from the magnitude of the micro lens formed on the color filter of other colors according to the solid state image sensor concerning claim 1 so that clearly By [than the micro lens of a color with high sensibility (for example, green) / bigger] raising spectral sensitivity as a thing, the magnitude of the micro lens of a color with low sensibility (for example, blue, red) A noise can be reduced about a color with low sensibility, and it becomes possible to improve the color reproduction field of a solid state image sensor.
[0017] Moreover, while it is possible to make easily the solid state image sensor concerning claim 1 according to the manufacture approach of the solid state image sensor concerning claim 3, modification of the height of a micro lens and modification of the resist for micro lenses are possible for every color of a color filter. The spectral sensitivity of R with low sensibility (red) and B (blue) can be improved further by this, and the color reproduction field of a solid state image sensor can be extended.
[0018]

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The solid state image sensor with which magnitude of the micro lens formed on the color filter of the color of 1 is characterized by differing from the magnitude of the micro lens formed on the color filter of other colors in the solid state image sensor which was equipped with two or more light sensing portions on the semiconductor substrate, and formed the color filter and the micro lens on said light sensing portion.
[Claim 2] The solid state image sensor according to claim 1 characterized by the filter array of a color filter having a BEIYA method or an INTARAIN method.
[Claim 3] The manufacture approach of the solid state image sensor characterized by forming a micro lens on the color filter of other colors after the magnitude of the micro lens formed on the color filter of the color of 1 is the manufacture approach of a different solid state image sensor from the magnitude of the micro lens formed on the color filter of other colors and forms a micro lens on the color filter of the color of 1.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view of cross-section structure having shown the production process of the solid state image sensor concerning an example 1.
[Drawing 2] It is the sectional view of cross-section structure having shown the production process of the solid state image sensor concerning an example 2.
[Drawing 3] It is the sectional view of cross-section structure having shown the production process of the conventional solid state image sensor.
[Description of Notations]
1 Semi-conductor Substrate
2 Light Sensing Portion
3 Charge Transfer Section
4 Lower Flattening Layer
5 Color Filter
6 Protection-from-Light Layer
7 Up Flattening Layer
8 Pattern
9 Pattern
10 Large Micro Lens
11 Small Micro Lens
12 Pattern
13 Micro Lens

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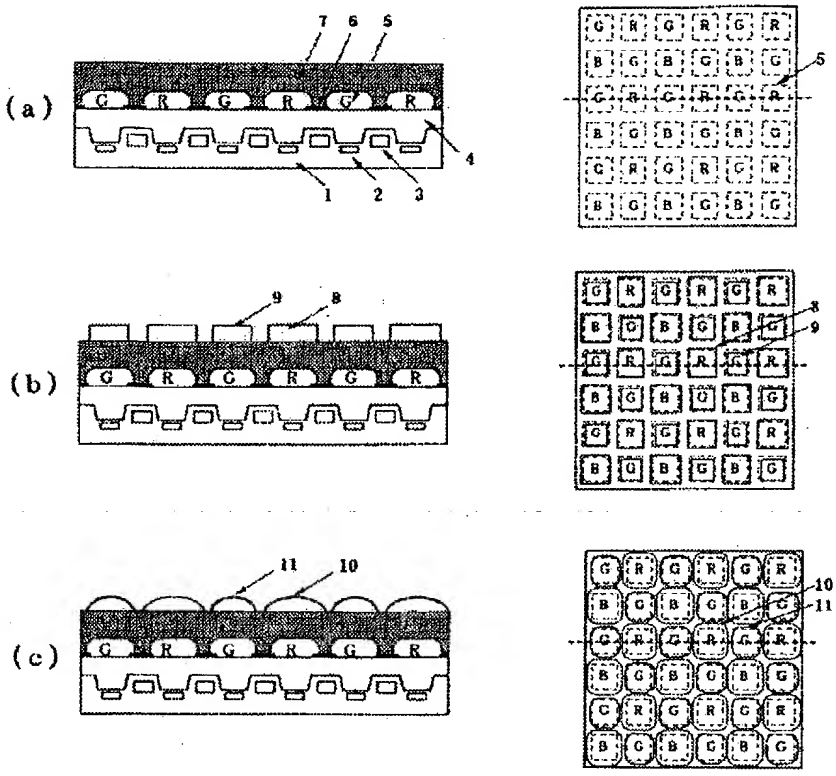
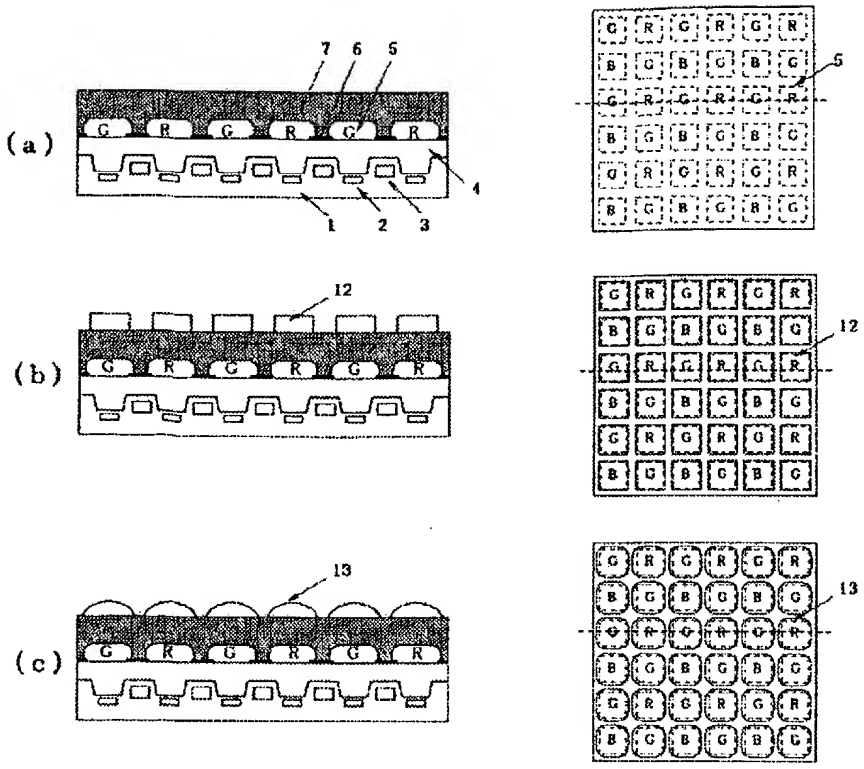
DRAWINGS

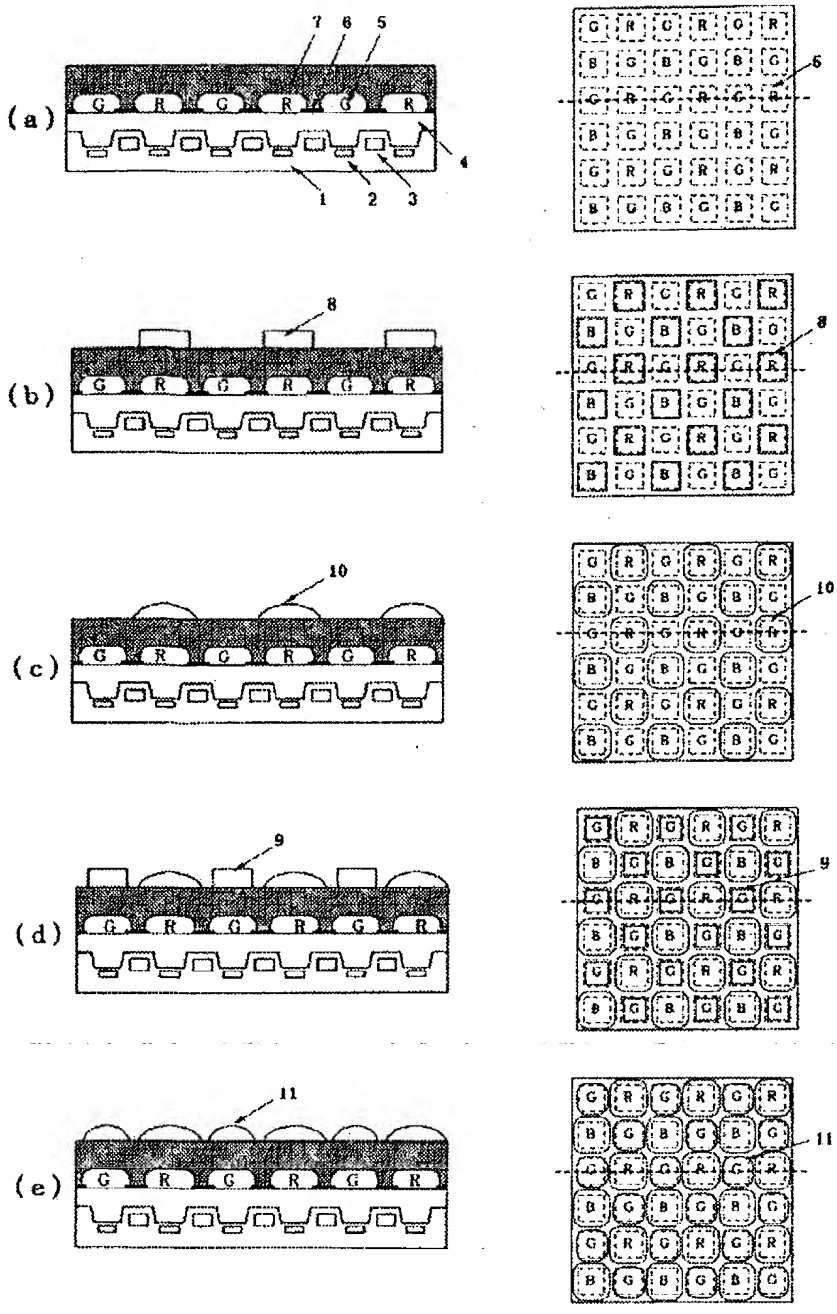
[Drawing 1]



[Drawing 3]



[Drawing 2]



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